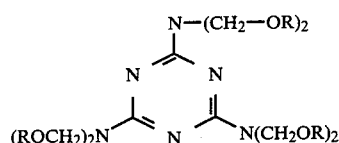


BETA-HYDROXYALKYLCARBAMYL-METHYLATED AMINOTRIAZINES AND CURABLE COMPOSITIONS CONTAINING THE SAME

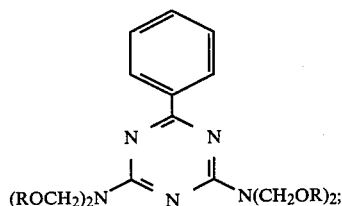
The present invention relates to curable compounds and compositions and to methods of making and using them. More particularly, the present invention relates to novel beta-hydroxyalkylcarbamyldimethylaminotriazine compounds and to curable compositions comprising the novel beta-hydroxyalkylcarbamyldimethylaminotriazine, optionally, an active hydrogen-containing material or an amino resin, and, optionally, a cure catalyst. Coatings cured from the compositions have exceptional resistance to detergent and salt spray exposure and improved solvent resistance, making them well adapted for use in powder coatings, coil coatings and can coatings. The curable compositions also act as efficient binders for fillers, such as glass and foundry sand.

BACKGROUND OF THE INVENTION

Curable compositions containing aminotriazine compounds are known in the art. As is shown in Koral et al., U.S. Pat. 3,661,819, for example, a preferred family of aminotriazine curing agents comprises (i) a triaminotriazine compound of the formula:



which will be depicted hereinafter as $\text{C}_3\text{N}_6(\text{CH}_2\text{OR})_6$; or (ii) a benzoguanamine compound of the formula:



which will be depicted hereinafter as $\text{C}_3\text{H}_5(\text{C}_6\text{H}_5)(\text{CH}_2\text{OR})_4$ wherein R is hydrogen or alkyl of from 1 to 12 carbon atoms. It is also known to use oligomers of such compounds, which are low molecular weight condensation products containing for example two, three or four triazine rings, joined by $-\text{CH}_2\text{OCH}_2-$ linkages, as well as mixtures of any of the foregoing. These are used to self-condense or used to cure active hydrogen-containing materials, especially polymers which contain carboxyl groups, alcoholic hydroxy groups, amide groups and groups convertible to such groups, such as methylol groups, as well as amino resins, such as hydroxymethylated melamine, urea, benzoguanamine, phenol and oligomers thereof, as well as methylated, ethylated and butylated ethers thereof. When such curable compositions are applied to substrates as coatings or used as binders for glass fibers or for foundry sand, and then cured, excellent properties in terms of hardness, solvent resistance, tensile strength, etc., are imparted to the articles.

It has now been discovered that if aminotriazines of general formulae (i) and (ii) are reacted with beta-hydroxyalkyl urethanes, derivatives are formed which are also reactive to self-condense and to crosslink amino resins and/or active hydrogen-containing polymers, but the new coatings which are formed have much improved properties, e.g., detergent, salt spray, adhesion, color retention and especially abrasion resistance and hardness over those of the prior art. When used as binders, e.g., for glass or for fine sand, shaped articles are produced which have high tensile strengths and less tendency to emit formaldehyde in use, making them highly suitable for use as insulation and as foundry core molds.

Although it is known, e.g., from Valko, U.S. Pat. No. 4,435,559, to use beta-hydroxy urethanes as cross linkers for active hydrogen containing compounds, none of these prior art compounds are aminotriazine derivatives, and no property enhancement appears to have been achieved—merely lower curing temperatures.

It is also known to produce hydroxy-functional melamine derivatives by, for example, reaction of melamine with propanolamine, e.g., hydroxypropyl-functional melamine. Hydroxy alkyl carbamate functional melamine derivatives can also be made by reacting cyanuric chloride with the adduct of diethylenetriamine and propylene carbonate.

It has also now been discovered that the reaction of hydroxyalkyl carbamates with alkoxymethyl or hydroxymethyl melamines and benzoguanamines is very easily accomplished. The reaction products formed are unexpected, in that the amino group of the beta-hydroxyalkyl carbamate reacts exclusively with the alkylol ether groups of the aminotriazine to give a blocked isocyanate having terminal hydroxyl groups. Of great interest, no crosslinked product is formed in this preparation. Such an economical synthesis provides the novel multifunctional compounds of this invention, containing wide ranging yet predictable amounts of urethane linkages, reactive hydroxyl groups, and blocked isocyanate moieties for further elaboration.

In addition to their functions, mentioned above, in self-condensation or co-condensation to provide solvent-resistant, unusually hard coatings, further utility is found in reaction injection molding, e.g., with polyisocyanates, and the like.

SUMMARY OF THE INVENTION

According to the present invention there are provided triazine compounds selected from

(i) a triaminotriazine compound of the formula $\text{C}_3\text{N}_6(\text{CH}_2\text{OR})_{6-x}(\text{CH}_2\text{NHCOOR}^1)_x$;

(ii) a benzoguanamine compound of the formula $\text{C}_3\text{N}_5(\text{C}_6\text{H}_5)(\text{CH}_2\text{OR})_{4-y}(\text{CH}_2\text{NHCOOR}^1)_y$;

(iii) an oligomer of (i) or of (ii); or

(iv) a mixture of at least two of any of (i), (ii) and (iii), wherein the R groups are, independently, hydrogen or alkyl of from 1 to 12 carbon atoms, the R^1 groups are, independently, beta-hydroxyalkyl of from 2 to 18 carbon atoms, alone, or combined with alkyl of from 1 to 18 carbon atoms, x is in the range of from about 3 to about 6, and y is in the range of from about 2 to about 4.

In preferred embodiments of the invention, x is in the range of from about 5 to about 6 and y is in the range of from about 3 to about 4. With respect to compound (i) R is preferably methyl and R^1 is beta-hydroxyethyl, beta-hydroxy propyl, e.g., a mixture of beta-hydroxy-alpha-methylethyl and beta-hydroxy-beta-methylethyl,